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#### Contention 1: The Space Industrial Complex

#### 3. Capitalism is not natural or inevitable, extending it to space is a political choice. Empirics prove it will be disastrous

Penny 20

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Space is our birthright. ​“Americans should have the right to engage in commercial exploration, recovery and use of resources in outer space,” President Donald Trump wrote April 6, 2020, issuing the ​“Executive Order on Encouraging International Support for the Recovery and Use of Space Resources.” In the stroke of a pen, Trump planted the U.S. flag on ​“the Moon, Mars and other celestial bodies.” As Trump declared these space lands and resources open for business, you could hear the cheers — mostly from ​“moonshot” corporations that have clamored to sweep away the patchy, unregularized Cold War-era space law in favor of new, unregulated corporate plunder of the solar system. While the institution of private land ownership is now widely taken for granted, it was — like many so-called natural things — invented. Before the muddied, grueling transition from feudalism to capitalism, peasants in Britain and much of Western Europe depended on their right to farm, forage and harvest on common, community lands. The land was controlled by local lords, but it belonged (in a loose, de facto sense) to the communities living on it and dependent upon it. Eventually, common lands were ​“enclosed” and became the private property of aristocrats. This exclusive right to land use (to own and profit from land) was the contrivance that established the new economic order. No longer held in common, the planet’s resources were parceled off to strictly private hands. No longer could peasants scrape by, subsisting on the commons. Instead, they depended on the grace and favor of a wage. Life in feudal times was no bucolic idyll, but enclosure was synonymous with disaster, destitution and death for many people. This model was mirrored in the capture, theft and enclosure of colony lands, the people (and resources) of which fueled the early capitalist transition and later the industrial revolution. Capitalism must grow to persist, and as it grows it must transform ripe, unregularized commons into private fiefdoms — at home and afar. So it seems only ​“natural” to carve up the moon into stretches of valuable real estate, just like Manhattan and the metal mines in the Democratic Republic of Congo. After all, Earth’s resources dwindle by the day, and boundless resources beyond the stratosphere could be a backstop for planetary scarcity. Never mind that our crisis of resources is, in part, the result of this system of private ownership that rewards ruthless, short-term profiteering at the expense of the long-term survival of the natural commons. This future access to a new natural commons is now a stress test on governmental priorities. As Trump proclaimed, ​“Outer space is a legally and physically unique domain of human activity, and the United States does not view it as a global commons.” Trump’s executive order to ​“encourage international support for the public and private recovery and use of resources in outer space” heralds yet another public-private boondoggle, where nominally public institutions thrash out fresh boundaries of corporate activity. As an example, look no further than SpaceX’s Crew Dragon capsule, which successfully transported NASA astronauts Bob Behnken and Doug Hurley to the International Space Station on May 31, 2020. The NASA-SpaceX crossover branding leaves no room for misinterpretation: The next small steps for mankind will be giant leaps for corporate America. Elon Musk, who founded SpaceX in 2002, talks misty-eyed about a relatively near future when humanity will have risen out of the mud, setting its sights on colonizing Mars — with SpaceX transportation rocketing there. In 2020, Musk began launching a cavalcade of thousands of satellites into low-Earth orbit to form the Starlink satellite system. As of November 2020, nearly 900 satellites had been launched (42,000 are planned in total). This network will potentially seed an extraplanetary monopoly for key economic infrastructure, such as domestic internet access. Fellow billionaire escapist Jeff Bezos, Amazon CEO, has been romanced by the wealth among the stars as well, founding his own aerospace company, Blue Origin, back in 2000. ​“We are going to build a road to space,” Bezos said in 2019. ​“And then, amazing things will happen.” Bezos has invited us all to cosplay his daydreams with the Amazon-funded, interplanetary sci-fi thriller The Expanse, in which a roll call of stock anti-heroes (the rogue policeman, the war-beleaguered pilot, etc.) tumble through a far future when only wise plutocratic innovators can plumb interstellar riches and deliver the solar system from interstellar war. Microsoft, too, has its fingers in the intergalactic pie, launching Azure Orbital in September 2020 to enable satellite operators on its cloud computing platform, along with a SpaceX partnership the following month. According to Forbes, 2019 was a record year for private space investments, with ​“venture capitalists [investing] $5.8 billion in 178 commercial space startups worldwide.” As Earth’s billionaires burnish the power of new stratospheric tech, Trump launched Space Force, the first new branch of the U.S. military in more than seven decades. ​“Space is the world’s newest war-fighting domain,” Trump said. ​“Amid grave threats to our national security, American superiority in space is absolutely vital.” Space exploration has long been tied to military ambition. From its Cold War founding, NASA’s task was to advance the practical interests of the American state as it squared off against the Soviet behemoth. The new field of battle included space-guided missiles and satellite technology. Astronauts are still generally selected from the ranks of the military. Grumman (now better known as half of Northrop Grumman) made parts for both the NASA spacecraft that leapt into the great unknown and the military machines that waged war in Vietnam. As the shadow of nuclear war retreats in the bright light of a digital dawn, the mission of Space Force is to protect the economic and military infrastructure (communications and surveillance technology) seemingly threatened by rival global powers (namely, Russia and China) gearing up their own military space operations. The 1967 Outer Space Treaty, signed by the United States, the United Kingdom and the Soviet Union, attempted to guard against the militarization and the privatization of our shared stratosphere. The treaty limited governmental (and non-governmental) bodies from sending nuclear weapons into space and prohibited the annexation of the moon and temptingly mineral-rich asteroids. As the treaty outlined, any country could use and explore outer space but there could be no ​“appropriation” of astral territory. It was, at heart, a disarmament treaty — one whose ropey legalities were enforced by the now-defunct Cold War brinkmanship between its main two signatories. The treaty never foresaw the dizzying rise of private enterprise clamoring for a slice of the sky. Nor did it foresee the slow shelving of publicly funded U.S. space exploration (especially the manned variety) that would allow venture capitalists to stake their claim in a new space scramble.

#### 4. Risks of private space activity vastly outweigh- government space programs are regulated and equitable. Private space risks handing a megalomaniac their own death star

Kaminska 14

(Izabella is an FT Alphaville reporter <https://www.ft.com/content/02aac296-a920-11e3-bf0c-00144feab7de> 3-14)

For a long time the idea of commercial space was an eccentric billionaire’s pipe dream. A fanciful desire of those with a penchant for Isaac Asimov novels. Not so any more. Elon Musk’s SpaceX has been sending payloads to space on a commercially viable basis since 2010. Sir Richard Branson’s Virgin Galactic is on track to take its first fully paid-up customers into near-space by the end of this year, all of which was revealed by my colleague John Sunyer’s recent piece on property space wars. And a company called Planetary Resources is making serious attempts to identify asteroids for commercial mining missions in the not too distant future. Small surprise then that the issue of extraplanetary property rights has been raised by the likes of Robert Bigelow, founder of Bigelow Aerospace, a company hoping to put private living quarters in space. Above all, Bigelow is worried that if the capitalist west doesn’t go about annexing celestial bodies in the name of private enterprise, some other nation will go empire-building in its own name instead. The argument pro property rights is simple. What we’re approaching is a new Wild West period for humanity. A time when anyone ingenious or intrepid enough to get themselves into space should rightfully be rewarded with ownership and autocracy over the land masses they discover or forge. Especially since this time around there are no native inhabitants, or at least none that we humans can divine, to be displaced in the process. Call it the classic expansionist approach to property allocation. Or as comedian Eddie Izzard once joked, stealing countries with the cunning use of flags. If you can claim it and defend it, it becomes yours. The problem with this way of thinking is that the Wild West is a poor analogy for space exploration. First there’s the access issue. Getting to the New World may have been harsh and costly, but it was still exponentially easier – and thus more equitable – than getting to space. Second, when the pilgrims set sail for America, they never looked back. Yes, they still depended on trade, but they did so on an equal footing with their trade partners because they had just as many valuable resources, if not more, to exchange. The American war of independence was about shedding the yoke of the old land, which still desired to rule the colonies despite their self-sufficiency. The same clearly does not apply to the hostile territory of space. The chance that any colonist on Mars, the Moon or an asteroid will be self-sufficient enough to break their dependence on Earth is infinitesimally small. To the contrary, private missions are likely to remain dependent on national jurisdictions for launches and life support for decades if not centuries. Is it a risk, then, that nation-states will see this as an invitation to go empire-building in space instead? Unlikely. Article II of the UN Outer Space Treaty already sets out the parameters clearly: “Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” It is a treaty we should be thankful for, not least because it paved the way to a truly unprecedented era of international co-operation, resulting in, among other things, the International Space Station. If any sovereign state dared to break it, say by invading the Moon, they would, without a shadow of a doubt, find themselves testing the international community, and consequently the established nuclear power balance here on Earth. That means, for as long as a space colony depends on Earth-based ties, the incentive for a nation-state to abide by Earth-based rules remains. It’s game theory. Unfortunately, the same cannot be said for private enterprise. A power-hungry space baron could feasibly argue that the UN treaty does not apply to them since they are not a sovereign state. Then there is also the caveat that the treaty only refers to celestial rather than man-made bodies. This is what you could call the dark side of space commercialisation. The point at which open access to space creates a Pandora’s box effect that in the name of competition compromises space co-operation and disrupts the power balance we’ve achieved both in space and on Earth. The point when a power-hungry billionaire could find a legal path to building his own Death Star. Elon Musk’s testimony to the Senate appropriations hearing on March 5 speaks of the potential power play in hand. As he argued, US national security is being undermined by the country’s dependence on Russian parts and launches, especially in light of the latter’s de facto annexation of the Crimea region. It would be much better, says Musk, if the US transferred more of its business to private enterprises like SpaceX. To Musk, access to space should be treated the same way access to commodities is treated on Earth. The only problem with this analogy is that private corporations competing for commodities still have to abide by national rules. Commercial space enterprises, it seems, would prefer it if sovereign states became dependent on private enterprise instead – the surest way of exposing Earth to the risk of a megalomaniac that wants to rename Mars one day.

#### 5. Utopian space fantasies are precisely that, they will never happen. Their purpose is to distract the public from a new age of capital accumulation

Marx 21

(Paris Marx is a socialist writer and host of the Tech Won't Save Us podcast. <https://www.jacobinmag.com/2021/07/billionaires-space-richard-branson-jeff-bezos-elon-musk> , 7-13)

But as these billionaires had their eyes turned to the stars and the media showered them with the headlines they craved, the evidence that the climate of our planet is rapidly changing in a way that is hostile to life — both human and otherwise — was escalating. Near the end of June, Jacobabad, a city of 200,000 people in Pakistan, experienced “wet bulb” conditions where high humidity and scorching temperatures combine to reach a level where the human body can no longer cool itself down. Meanwhile, half a world away, on the West Coast of North America, a heat dome that was made much worse by climate change sent temperatures soaring so high that the town of Lytton, British Columbia, hit 49.6ºC, beating Canada’s previous temperature record by 4.6ºC, then burned to the ground when a wildfire tore through the town. The contrast between those stories is striking. On one hand, billionaires are engaging in a dick-measuring contest to see who can exit the atmosphere first, while on the other, the billions of us who will never make any such journey are increasing dealing with the consequences of capitalism’s effects on the climate — and the decades its most powerful adherents have spent stifling action to curb them. At a moment when we should be throwing everything we have into ensuring the planet remains habitable, billionaires are treating us to a spectacle to distract us from their quest for continued capitalist accumulation and the disastrous effects it is already having. The Spectacle of Billionaires in Space Last May, we were treated to a similar display of billionaire space ambition. As people across the United States were marching in the streets after the murder of George Floyd and the government was doing little to stop COVID-19 from sweeping the country, Elon Musk and President Donald Trump met in Florida to celebrate SpaceX’s first time launching astronauts to the International Space Station. As regular people were fighting for their lives, it felt like the elite were living in a completely separate world and had no qualms about showing it. They didn’t have to make it to another planet. Over the past few years, as the billionaire space race has escalated, the public has become increasingly familiar with its grand visions for our future. SpaceX’s Elon Musk wants us to colonize Mars and claims the mission of his space company is to lay the infrastructure to do just that. He wants humanity to be a “multiplanetary” species, and he claims a Martian colony would be a backup plan in case Earth becomes uninhabitable. Meanwhile, Bezos doesn’t have much time for Mars colonization. Instead, he believes we should build large structures in Earth’s orbit where the human population can grow to a trillion people without further harming the planet’s environment. As we live out our lives in O’Neill cylinders, as they’re called, we’ll take occasional vacations down to the surface to experience the wonder of the world we once called home. Neither of these futures are appealing if you look past the billionaires’ rosy pitch decks. Life on Mars would be horrendous for hundreds of years, at least, and would likely kill many of the people who made the journey, while the technology for massive space colonies doesn’t exist and similarly won’t be feasible for a long time to come. So, what’s the point of promoting these futures in the face of an unprecedented threat to our species here on Earth? It’s to get the public on board for a new phase of capitalist accumulation whose benefits will be reaped by those billionaires. To be clear, that does not even mean anything as grand as asteroid mining. Rather, its form can be seen in the event last May: as Musk and even Trump continued to push the spectacle of Mars for the public, SpaceX was becoming not just a key player in a privatized space industry but also in enabling a military buildup through billions of dollars in government contracts. The grand visions, rocket launches, and spectacles of billionaires leaving the atmosphere are all cover for the real space economy.

#### Contention 2: A New Hope

#### 1. A progressive vision of space would tax billionaires to fund public space efforts

Robinson 18

(Kim Stanley, <https://inthesetimes.com/article/kim-stanley-robinson-space-exploration-socialism-mars>, 4-22)

So how should progressives think about SpaceX? They should be grateful that at least one billionaire is interested in space science. Actually there’s more than one. But I think it’s legitimate to go further and ask, ​“Why are there people as rich as this anyway?” Why aren’t there progressive taxes on both income and capital assets, as economist Thomas Piketty suggested, such that the richest people max out at a certain nicely high number, beyond which wealth is passed through to the collective that made it? People and corporations could be taxed at the high rates we had under the Eisenhower Administration, for instance, with perhaps the additional perk that individuals could choose which government programs some portion of their taxes would go to — a kind of direct democracy support for the different functions of government. If the various agencies’ funding was partly a matter of popular ​“vote by taxes,” rather than entirely the result of Congress’ corrupted appropriation process, then it would be interesting to see how much money NASA ended up with, as well as the National Science Foundation (NSF), National Institutes of Health (NIH) and so on. If you were president, would your budget proposal put money toward these agencies? I would look at the relative worth of each agency and how much of a budget increase it could handle. My proposal would suggest that NASA be funded at about $100 billion a year (currently it’s $20 billion), taken out of the Pentagon budget (currently $770 billion a year), because many of the same industries support and are supported by both agencies. I’d fund NSF at $200 billion a year (currently $7 billion), and the Department of Energy at $100 billion. NIH $200 billion a year. Then I’d let the scientists figure out how best to spend that money. They would have to scramble at first to find enough worthy projects — a good problem to have. Putting humans on Mars would be low on my list. Our robots are doing fine there. I’d like to see robotic explorers sent to the moons of Jupiter and Saturn first. What does post-capitalist space exploration look like? It looks like NASA. It’s government, exploring a commons of sorts, doing it in the usual ​“of the people, by the people and for the people” way.

#### 2. Nationalizing space industries socializes risk and reward- public funding is the basis of most innovation, private space guts progress through brain drain

Aronoff 18

(KATE ARONOFF is a staff writer at The New Republic and author of Overheated: How Capitalism Broke the Planet — And How We Fight Back. <https://inthesetimes.com/article/elon-musk-spacex-tesla-falcon-heavy-launch> , 2-8)

Scientific American gawked, ​“Elon Musk Does It Again,” praising the ​“bold technological innovations and newfound operational efficiencies that allow SpaceX to not only build its rockets for less money, but also reuse them.” That view — shared by several other outlets — fits comfortably with the Tony Stark-like image Musk has crafted for himself over the years: a quirky and slightly off-kilter playboy genius inventor capable of conquering everything from outer space to the climate crisis with the sheer force of his imagination. One of Musk’s long-term goals is to create a self-sustaining colony on Mars, and make humanity an interplanetary species. He hopes to shoot two very wealthy people around the moon at some point this year. Musk has invested an awful lot of public money into making those dreams a reality. But why should Americans keep footing the bill for projects where only Musk and his wealthy friends can reap the rewards? Enter: the case for nationalizing Elon Musk, and making the U.S. government a major stakeholder in his companies. The common logic now holds that the private sector — and prodigies like Musk, in particular — are better at coming up with world-changing ideas than the public sector, which is allegedly bloated and allergic to new, outside-the-box thinking. Corporations’ hunt for profits and lack of bureaucratic constraints, it’s said, compel cutting-edge research and development in a way that the government is simply incapable of. With any hope, more of these billionaires’ breakthroughs than not will be in the public interest. The reality, as economist Mariana Mazzucato argues in her 2013 book The Entrepreneurial State: Debunking Public vs. Private Sector Myths, is very different. Many of the companies that are today considered to be headed by brilliant savants — people like Steve Jobs and, yes, Elon Musk — owe much of their success to decades of public sector innovation, through repackaging technologies developed over the course of several decades into new products. Take the iPhone, essentially a collection of Defense Department research and National Science Foundation-grant projects packed into one shiny machine. “The prospect of the State owning a stake in a private corporation may be anathema to many parts of the capitalist world,” Mazzucato writes, ​“but given that governments are already investing in the private sector, they may as well earn a return on those investments.” As she notes, Musk’s future-oriented empire — Tesla Motors, SolarCity and SpaceX — has benefitted from around $5 billion in local, state and federal government support, not to mention many years of foundational public research into programs like rocket technology. SpaceX itself exists largely for the sake of competing for government contracts, like its $5.5 billion partnership with NASA and the U.S. Air Force. The U.S. Department of Energy invested directly in that company, as well as in Tesla’s work on battery technology and solar panels. The latter is perhaps the biggest success story of the Department of Energy stimulus grant that also supported Solyndra, a solar energy company reliably held up by the Right as an example of the government’s failure to make wise investment decisions. ​“Taxpayers footed the bill for Solyndra’s losses — yet got hardly any of Tesla’s profits,” Mazzucato notes. As Mazzucato finds, the private sector hasn’t done much to earn its reputation as a risk-taker. Corporations and venture capitalists often adopt conservative thinking and fall into ​“path dependency,” and are generally reluctant to invest in important early-stage research that won’t necessarily turn a profit in the short-run. This kind of research is inherently risky, and the vast majority of this kind of protean R&D (research and development) fails. For every internet — birthed in the Defense Department — there are a well over a dozen Solyndras, but it’s virtually impossible to have one without the other. The problem runs deeper still. Whereas in the past public sector research has been able to attract top-tier talent, the myth that the private sector can do what the State can’t has created a negative feedback loop whereby bright young scientists and engineers flock toward a private sector that goes on to further its reputation for being the place where the real innovation is happening. The alternative Mazzucato suggests is to socialize risk and reward alike, rather than simply allowing companies that enjoy the benefits of public innovation to funnel their profits into things like stock buybacks and tax havens — or, for that matter, flamethrowers. When companies like SpaceX make it big, they’d be obligated to return some portion of their gains to the public infrastructure that helped them succeed, expanding the government’s capacity to facilitate more innovative development. All this is not to say that there isn’t a critical role to play for people like Jobs and Musk in bringing new technology to the market. In all likelihood, Tesla’s Powerwall and SolarCity panels will play a key role in our transition off of fossil fuels. But lionizing Musk as the sole creator of the Powerwall and this week’s space launch stands to perpetuate a dangerous series of myths about who’s responsible for such cutting-edge development. Through smart supply-and-demand-side policy, states can play a crucial role in shaping and creating markets for the technologies we’ll need to navigate the 21st century. This can happen not just through R&D but also through developments like fuel efficiency standards, which encourage carmakers to prioritize vehicles that run off of renewable energy. Given the mounting reality of climate change and the necessity to rapidly switch over to a clean energy economy, there’s also a bigger question about how actively the state should be encouraging certain kinds of research and manufacturing. During World War II, the United States essentially had a planned economy: By 1945, around a quarter of manufacturing in the country was under state control. The reason for that was simple — the U.S. government saw an existential threat, and directed some of its biggest corporations to pitch in to stop it or else risk getting taken over by the state. There’s some Cold War nostalgia to hoisting shiny objects into orbit — a telegenic show of America’s technological supremacy. But it may not be much solace to coastal residents forced to flee in the coming decades, whose homes are rendered unlivable by a mixture of extreme weather and crumbling, antiquated infrastructure. And if you’ve watched any number of big-budget sci-fi productions over the last several years, it’s not hard to imagine Musk’s Martian colony spinning off into some Elysium-style eco-apartheid, where the rich — for the right price — can escape to new worlds while the rest of us make do on a planet of dystopian slums, swamps and deserts. Today, the risk posed by climate change is greater still than that posed by fascism on the eve of World War II, threatening to bring about a planet that’s uninhabitable for humans, and plenty hostile to them in the meantime. In such a context, do we need to launch cars into space? Maybe not. If the public sector is going to continue footing the bill for Elon Musk’s fantasies, though, he should at least have to give back some credit, and a cut of the profits.

#### 4. No turns- space billionaires aren’t unique geniuses, they are accidents of history. Allowing them to control space guarantees the worst aspects of exploitative capitalism take over the galaxy

Spencer 19

(Keith A., Senior Editor, https://www.salon.com/2019/07/28/earths-robber-barons-are-salivating-over-bringing-authoritarian-capitalism-to-space/)

If the Nazis were to follow imperialism to the next logical step, and establish human colonies on other worlds — asteroids, moons, space stations, or on planets like Mars — a social and political system rooted in oppression, hierarchy and racial superiority would spread, like an infection, to other distant bodies where they would be far more difficult to extract. Part of that is due to an intractable communication problem: even between the most distant regions of Earth, the speed of light is not a noticeable constraint on the amount of time it takes to communicate. The same is not true in space. Authoritarians, of both the Nazi and the corporate variety, are not necessarily fond of free speech nor free communication; they are powerful tools for upsetting the social and political order. Even here in the United States, supposed bastion of liberal democracy, we've seen this play out before. In 2011, the Bay Area Rapid Transit (BART) public transit system suppressed communications networks in order to stifle dissent. As protests over the BART police shooting of Charles Blair Hill spread around the Bay Area, the regional transit system literally turned off the underground cell phone towers that would allow cell and data transmission while underground. The agency, unwisely, openly admitted it: "Organizers planning to disrupt BART service stated they would use mobile devices to coordinate their disruptive activities and communicate about the location and number of BART Police," the transit agency said. "A civil disturbance during commute times at busy downtown San Francisco stations could lead to platform overcrowding and unsafe conditions for BART customers, employees and demonstrators." The American Civil Liberties Union issued a harsh rebuke, and questioned whether the move was even legal for a government agency to do this. "All over the world, people are using mobile devices to protest oppressive regimes, and governments are shutting down cell phone towers and the Internet to stop them," said Michael Risher, a staff attorney for the American Civil Liberties Union of Northern California. "It's outrageous that in San Francisco, BART is doing the same thing." If this is how an American governmental agency behaves when confronted with the prospect of a legitimate peaceful protest, imagine how pro-Martian colonizer Elon Musk — who notoriously detests labor — will behave when his Martian dishwashers strike for higher wages. My point is, if you think that social and political struggles are difficult on Earth, where oxygen is free and the outside is traversable without an airtight suit, just wait until you see what happens when you bring humans to Mars — a planet where round-trip communication with Earth takes forty minutes at a minimum, and nighttime surface temperatures vary between -100 and -195° Fahrenheit. On our capitalist planet, there are no workers whose employers can threaten to leave them stranded, 80 million miles from home, if they don't do their bidding. On Mars, a disgruntled worker's employer could compel them to work by threatening to ever let them go home to Earth again. The potential for slavery on the red planet cannot be underestimated. Historically, the worst capitalist labor abuses on Earth happen to the most powerless workers in situations where no one is looking. Horrific tales of sexual harassment in Antarctica made sense inasmuch as its barrenness makes it an ideal place to be manipulative without anyone noticing. Mines, given their remote nature, are often rife with exploitation — and the history of miner treatment should give us pause as to how workers on Mars or on one of Jeff Bezos's space stations might be treated. This warning is prescient currently because of the intense focus of both government and private actors on the potential to privatize space travel. NASA Administrator Jim Bridenstine wants to create a "robust commercial marketplace" for space travel, has proposed a public-private partnership for the moon, and has spoken of privatizing the international space station. Elon Musk, one of NASA's suppliers in the brave new privatized world, is perfervid about building a Mars colony. Jeff Bezos, the richest human in the world, plans to build giant space stations; his rationale for space colonization is that "we are in the process of destroying this planet," something he actually stated with no palpable sense of irony. There are many who adulate Musk and Bezos, and view them as our generation's heroes. Yet the fact that these men honestly believe they are the ones to lead humans to space has nothing to do with any of their unique qualifications; it is due to a series of historical accidents that randomly thrusts sociopaths to the top of the capitalist food chain. Five decades of deregulation, neoliberal economic policy, and reduced taxation on the highest tax bracket have led us to a unique point in human history, where a few individuals are so wealthy that they have the ability to fund space travel. Again, this is not because these individuals are uniquely competent, nor qualified, to jumpstart colonization; it is an accident of history and economics that makes this situation possible. Nothing more. My fear with space colonization is that humans tend to think of it as inherently different than other political struggles, merely because humans haven't gone to space yet. The idea of space colonization as a cool, fun, exciting, sci-fi thing inhibits our ability to think critically about what it would actually mean to let a bunch of tech CEOs unilaterally colonize the solar system. There are precedents for the political aftereffects of space colonization: we have seen situations where a controlling institution tries to stifle communication on their property to prevent protest; we have seen how workers are exploited in cordoned spaces where their employers think no one is paying attention; we have seen how corporations entrap workers in hostile environments by giving them housing and food, and using that as a wedge to prevent dissent; and we have seen how corporations harvest the labor of the poor and vulnerable in order to avoid paying first-world wages to people who expect benefits. All of these scenarios seem likely to play out in our future if we don't fight back against the space imperialists. If you thought capitalism on Earth was horrific, wait till you see what it looks like in a vacuum.

**Private space enterprise *requires* and *contributes to*massive inequality--it’s viewed as a *spatial fix* that allows infinite expansion of state-backed colonialism**

**Penny 20**

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The eye-watering upfront costs of these exploratory, high-risk, high-reward endeavors can be absorbed by Silicon Valley venture capitalists and the personal fortunes of its aristocracy**. A concentration of capital stands ready to risk big money to secure a stake in future markets** (which will double down on its power in existing ones). The point is to ensure a slice of the territory everyone else will be clamoring for. This form of ​“creative destruction”—an idea developed by economist Joseph Schumpeter, understood in neoliberalism to describe the boom-bust cycle of innovation — **is often packaged in the mythology of moonshot genius that drives human progress**. But Schumpeter’s theory has a less discussed underbelly: Such creative destruction is usually twinned with **market capture.** As competitors are tossed onto the **scrap heap of history** by their own sudden irrelevance, **oligarchies and monopolies flourish**. The riches of the asteroid belt make earthly mining look positively parochial. The problem is that a sudden, vast supply of (formerly) precious metals would make market prices plummet. Journalist Aaron Bastani, author of Fully Automated Luxury Communism, notes that satellite-delivered digital information has the potential to replace our earthbound Internet networks with ​“space-based global Internet” — the way music streaming has replaced CDs and CDs replaced cassettes and vinyl — or to at least render them much cheaper (through, for example, open-access 3D printing). SpaceX and Blue Origin surely share a goal to make space transport cheaper. The question is, for whom? **These ventures train their sights on infinite excess**, with dwindling marginal costs as the supply of key materials and digital resources expands. This paradigm is great for those interested in the advancement of human civilization, but not so much for a grinning billionaire’s fixation on the bottom line. At first glance, expanding industry beyond Earth sounds like a pragmatic fix to the **earth-shatteringly simple dilemma faced by capitalism**: that it must grow to survive, but the planet **it grows upon is finite**. But to maintain profit margins in conditions of plenty (a demand of industry), **legal and political fixes** are required. If you exclusively own mining rights to asteroids rich in platinum — and precious little platinum is left on Earth — you can charge whatever you like for platinum. The diamond industry perfected this technique decades ago. (Elon Musk’s family fortune comes partially from a Zambian emerald mine.) Hence, the focus of the new space race is not on the production of goods or their most efficient sourcing, but on **ownership of land and transport networks**. In this latest phase of capitalism, as national growth slows, productive industries dwindle and wealth concentrates in fewer hands. As economist Thomas Piketty has observed, this phase is accompanied by a pivot toward rent-seeking as a profit mechanism. In other words, the scramble for space is the scramble to own satellites and ​“starways,” gatekeep the riches of the solar system and charge rent on the moon. Against this backdrop, Space Force might seem retrograde, a warped nostalgia for a time when the space race was about petty terrestrial wars rather than Musk’s supposedly enlightened vision to colonize Mars. **In reality, the two visions go hand in hand. Military might physically captures and secures territory, enforces the American political and legal apparatus and ensures business can function** (even on the moon). The darlings of this new space age paint their vision as daring futurism, a wild-eyed libertarian dream of human elevation. **But history repeats and the story is old.**Like Bezos and Musk, Cecil Rhodes — mining magnate and premier villain of the British Empire — also succumbed to dreams of wealth in the night sky. ​“**Expansion is everything**,” Rhodes said. ​“I would annex the planets if I could.” Where technology opens up the yawning unknown of new territory glittering with potential profit, private enterprises hustle for dominance — backed by the military and legal capacities of earthbound nations. **Colonialism in space is not some post-humanist utopia**, but the age-old dominion of land barons and mining magnates, billionaires sloughing off the wreckage of one planet and setting out for the stars.

**There is no such thing as “space philanthropy”- private actors are interested in self promotion, not saving humanity. Their efforts directly gut government programs to allow market capture**

**Riederer 18**

(RACHEL <https://www.jacobinmag.com/2018/07/space-barons-review-elon-musk-bezos-thai-cave>, 7-19)

Bracketed for gendered language

**It is impossible for any reader living through the ravages of global warming to scan these sentiments without skepticism**. If someone is going to invest enormous amounts of wealth and time in an engineering project, gathering together some of the smartest scientists on the planet to develop and test creative solutions to an intractable problem, **in the interest of saving the future of humanity, how could you choose any focus but climate change**? Davenport doesn’t ask, taking at face value the space barons’ declarations that they are motivated by planetary rescue. For those interested in the movement to privatize space exploration and space itself, The Space Barons does serve as a useful primer, laying out the timelines and geneses of these companies. But it stops short of posing critical questions about what it means for such enterprises to be **privately held** — a line of questioning that, given the history of labor problems and tendencies toward monopolization at the barons’ non-space companies Amazon and Tesla, might be **very good questions to ask indeed.**It instead leans heavily on colorful anecdotes about the companies’ founders and their philosophies. Bezos, obsessed with the accomplishments of NASA ever since he watched the moon landing at the age of five, commissions an underwater search party to recover the Apollo-era Saturn V rocket engines from the floor of the Atlantic. Branson evangelizes about the “life-changing” effects of experiencing space and trains for spaceflight in a spinning centrifuge, declaring the adventure “rather fun.” A young Musk floats an idea for a Martian greenhouse project straight out of the sci-fi of Kim Stanley Robinson, “a P.T. Barnum-like stunt” in which he would launch a greenhouse full of seeds and growing medium onto the surface of Mars and make the red planet bloom. A more seasoned Musk sues the US Air Force for the right to compete for national-security launches alongside established aerospace contractors like Boeing and Lockheed Martin. Running through all of these engineering and business adventures is the rivalry between Bezos and Musk. Both are working toward the same goal: developing and producing rockets that can be reused on multiple flights, making regular spaceflight more efficient. When SpaceX successfully launched — and then re-landed — the Falcon 9 for the first time, in December of 2015, Musk was ecstatic. Until he saw a tweet from Bezos offering his congratulations and saying “Welcome to the club!” Bezos had done the same, with his rocket, the New Shepard, the month before. Musk took the success of the Falcon 9 as validation of his long-term goals. “It really quite dramatically improves my confidence that a city on Mars is possible,” he said. “That’s what this is all about.” Well, it’s part of what this is all about. **The desire to be beloved, to be seen as a great visionary rescuer**, is what’s so grating about Musk’s recent public announcements of altruism, and it’s present throughout the history of all of the companies profiled in The Space Barons. In addition to amassing billions of dollars in personal wealth and living out their rocket-launching boyhood dreams, the space barons insist on framing their pursuits as **inspirational and civic-minded**. The tension in the recent dust-up over Musk’s unused Thai-cave rescue pods isn’t about whether Musk and his engineers created the rescue pods, but why. Was it a good-faith effort to help a group of desperate kids, or a megalomaniacal attempt to place himself and his companies at the center of a giant news story? Musk wants the answer to be simple, defending his behavior by insisting that “something’s messed up if this is not a good thing.” **The space barons are fond of metaphors of exploration and frontiers**. They compare themselves to Shackleton and Magellan. “The thing that actually gets me the most excited about it,” Musk says, “is that I just think it’s the grandest adventure I could possibly imagine. It’s the most exciting thing — I couldn’t think of anything more exciting, more fun, more inspiring than to have a base on Mars.” This enthusiasm is fine, of course. **But it also shatters the notion that Musk and company are trying to thrust humanity into space to save us all from planetary disaster**. Outer space, a flooded network of caves — anywhere dangerous and sparsely visited will draw to it both adventurers and rescuers. But their work proceeds differently, and someone who’s out for a grand adventure shouldn’t **pretend to be a planetary EMT.** Perhaps the worst thing about the space barons is that they’re burnishing their reputation by rushing into areas **vacated by state divestment** — divestment that in many cases, **they themselves have helped promote**. Witness Musk’s recent pledge to “fund fixing the water in any house in Flint that has water contamination” **while lavishly contributing to the Republican Party**. Musk and his brethren have hoovered up billions of dollars, funded plutocratic causes — and then balk when anyone raises a peep about their narcissistic antics. “They were driven by the business opportunities in space, by adventure, and by ego,” Davenport writes of the group he profiles. “[I]magine the Promethean legacies they’d leave after opening up the Final Frontier.” Yet **Promethean legacy is a double-edge sword**: the trickster who stole fire from the gods and gave it to [hu]mankind is as much a symbol of tragic consequences as of human progress.

DAs

AT: Asteroid Mining DA

Defense

Not enough asteroids meet all criteria for viability

Rincon, science editor, 14

(Paul, <https://www.bbc.com/news/science-environment-25716103>, 1-13)

A new study might contain some bad news for companies hoping to mine asteroids for their valuable ores. In the last couple of years, start-ups - including one backed by Sir Richard Branson - have announced plans to extract resources from space rocks. But calculations by Dr Martin Elvis suggest our cosmic neighbourhood might not be such a treasure trove after all. The Harvard astrophysicist argues just 10 near-Earth asteroids might be suitable for commercial-scale mining. But Eric Anderson, co-founder of asteroid mining company Planetary Resources, told BBC News that the values quoted in the study were off - conservatively - by a factor of 100. Dr Elvis, from the Harvard-Smithsonian Center for Astrophysics in Cambridge, US, has developed an equation to estimate the number of asteroids in the Solar System that could be exploited in a cost-effective way. His research paper is in press at the journal Planetary and Space Science, and has been posted on the pre-print server Arxiv.org. In 2012, Planetary Resources, backed by billionaire investors including Hollywood director James Cameron as well as Google executives Larry Page and Eric Schmidt, unveiled their vision of using robotic spacecraft to squeeze the chemical components of fuel as well as minerals out of asteroid rocks. Several months later, the company was joined by a competitor - Deep Space Industries - which plans to use low-cost spacecraft called Fireflies and Dragonflies to reconnoitre and return samples from near-Earth asteroids. Advocates of asteroid mining say it could turn into a trillion-dollar business, but some experts have been sceptical of the idea. Concentrating efforts While acknowledging the uncertainties, Dr Elvis worked out the factors that would make an asteroid commercially viable to mine and what fraction of known space rocks met these requirements. He assumed that mining operations would want to focus on iron-nickel asteroids (known as M-type), considered the most promising targets for finding so-called platinum-group metals. These include platinum, along with iridium, palladium and others. These are rare in the Earth's crust because they dissolve in molten iron, instead being mainly concentrated in the planet's core. Platinum and palladium are the most economically important, having a wide range of uses in industry. But according to the analysis, just 1% of near-Earth asteroids are rich in these elements. Suitable asteroids also need to be relatively easy to reach, further narrowing the pool by ruling out all but the nearest objects to Earth. The operative parameter here is delta-v - the change in velocity needed to send mining equipment to the target and return with a larger mass of ore. The size of the target is also a factor; the paper suggests it wouldn't be worth mining asteroids smaller than about 100m because the total value of the ore they would produce wouldn't be enough to cover the costs of a space mission. However, Dr Elvis points out that the ore values in his analysis range from a low of $800m to a high of $8.8bn. "Such a large range of values could greatly change the profitability of a venture, making more accurate assays necessary," he explained.

Won’t solve earth mining-market forces

Whittington 17

(Mark, https://us.blastingnews.com/opinion/2017/01/why-mining-asteroids-and-the-moon-will-not-destroy-the-world-s-economy-001401771.html , 1-17)

The idea that asteroid mining is going to destroy the world economy exhibits a misunderstanding about how the new industry will work. The market for most Space materials, whether from the asteroids or the moon, will not be on Earth, for the most part, but in space. Water from the moon would be used to make rocket fuel and to support a lunar colony. Metals from worlds like 16 Psyche would be used to build things in space, not brought back to Earth as a building material. That arrangement would eliminate the need to ship everything from Earth.

Advantage is 40 years away

Price 17

(Greg, <https://www.newsweek.com/space-asteroids-china-united-states-607598>, 5-11)

The Chinese, evidently, intend to carry out the futuristic and intriguing mission by landing a spacecraft on an asteroid and using rocket boosters to slingshot the rock into the Moon's orbit. However, it could take upwards of more than 40 years to actually mine materials from the asteroids.

Asteroid mining is dead, no infrastructure, no investor support

Araxia 19 “How the asteroid-mining bubble burst A short history of the space industry’s failed (for now) gold rush” by Atossa Araxia Abrahamian, Jun 26, 2019, https://www.technologyreview.com/s/613758/asteroid-mining-bubble-burst-history/

In the best of worlds, Chris Lewicki and Peter Diamandis might have changed the course of human civilization. Their startup, Planetary Resources, was launched in 2012 with the modest dream of mining asteroids for minerals, metals, water, and other valuables. The founders’ résumés and connections gave the zany idea institutional legitimacy: Lewicki had worked on major NASA missions such as the Mars Spirit and Opportunity rovers, and Diamandis was a well-known space--tourism booster. Together with a third partner, Eric Anderson, Planetary Resources had raised $50 million by 2016, of which $21 million came from big-name investors including Google’s Eric Schmidt and filmmaker James Cameron. This story is part of our July/August 2019 issue Before long, a competitor called Deep Space Industries (DSI) appeared on the scene. It raised much less cash: just $3.5 million, supplemented by some government contracts. But it had its own high-profile backers, pie-in-the-sky goals, and a particularly evangelical board member named Rick Tumlinson, who made the rounds at conferences pitching the company’s vision. “Crazy ideas: that’s what moves culture forward,” he said at a 2017 event in New York. “Nothing says this is impossible except our own belief systems.” It was sci-fi come to life—and everybody loved it. “Space mining could become a real thing!” headlines squealed. Amazon CEO Jeff Bezos began speaking of a future in which all heavy industry took place not on Earth, but above it. NASA funded asteroid-mining research; the Colorado School of Mines offered an asteroid-mining degree program; Senator Ted Cruz predicted that Earth’s first trillionaire would be made in space. “There was a lot of excitement and tangible feeling around all of these things that we’ve been dreaming about,” says Chad Anderson (no relation to Eric), the CEO of Space Angels, a venture capital fund that invests in space-related companies. Sign up for The Airlock — your gateway to the future of space technology Also stay updated on MIT Technology Review initiatives and events?YesNo Also crucial to the money-making opportunities was the burgeoning commercial space sector’s lobbying, which shepherded the SPACE Act through Congress in 2015. This not--uncontroversial bill included a “finders, keepers” rule whereby private American companies would have all rights to the bounty they extracted from celestial bodies, no questions asked. (Before that, property rights and mining concessions in space, which belongs to no country, were not a given.) That, in turn, would make it possible to work toward a goal that Eric Anderson predicted could be reached by the mid-2020s: extracting ice from asteroids near Earth and selling it in space as a propellant for other missions. Water can be broken into hydrogen and oxygen to make combustible fuel, or—as in DSI’s technology—just heated up and expelled as a jet of steam. “Both companies believed one of the early products would be propellant itself—that is, water,” says Grant Bonin, the former chief technology officer of Deep Space Industries. “What DSI had been doing is developing propulsion systems to run on water. And everyone who buys one is creating an ecosystem of users now that can be fueled by resources of the future.” By the spring of 2017, Planetary Resources was operating a lab in a warehouse in Redmond, Washington, decorated with NASA paraphernalia and vintage pinball machines. Engineers tinkered with small cube satellites behind thick glass walls, crafting plans to launch prospecting machines. Luxembourg had given the company a multimillion-dollar grant to open a European office. Japan, Scotland, and the United Arab Emirates announced their own asteroid-mining laws or investments. The stars had burned through their red tape. The heavens were ready for Silicon Valley. Then things started going south. Last summer, Planetary failed to raise the money it was counting on. Key staffers, including Peter Marquez, the firm’s policy guy in Washington, had already jumped ship. “We were all frustrated about the revenue prospects, and the business model wasn’t working out the way we’d hoped,” recalls Marquez, who now works for a Washington, DC, advisory shop called Andart Global. “There was more of a focus on the religion of space than the business of space,” Marquez adds. “There’s the religious [segment] of space people who believe that almost like manifest destiny, we’re supposed to be exploring the solar system—and if we believe hard enough, it’ll happen. But the pragmatists were saying there’s no customer base for asteroid mining in the next 12 to 15 years.” A conceptual illustation of asteroids CHRISSIE ABBOT Amid rumors that it was auctioning off its gear, Planetary Resources was acquired last year by ConsenSys, a blockchain software company based in Brooklyn that develops decentralized platforms for signing documents, selling electricity, and managing real estate transactions, among other things. Anderson Tan, an early investor in Planetary Resources, was baffled by the acquisition—and he’s the kind of blockchain guy who promotes other blockchain guys’ blockchain ventures on LinkedIn. “I honestly have no idea … I was shocked. I think they wanted to acquire the equipment and assets,” he says. “For what? I’m not so sure.” DSI, in turn, was acquired by an aeronautics company named Bradford Space. These acquisitions aren’t taking the companies anywhere. “They’re gone; they’re done. They don’t exist,” says Chad Anderson. The lack-of-vision thing What went wrong? Predictably, ex--employees and investors tell slightly different stories. Bonin blames DSI’s demise on investors’ unwillingness to take long-term risks. “We had a plan that would take off after a certain point, and we didn’t get to that point,” he explains. “And we were only $10 million away from hitting that point, but our planning was decades long, and a VC fund’s life cycle is one decade long. They’re incompatible.” Meagan Crawford, who worked with Bonin and is now starting her own venture capital fund for commercial space startups, concurs: “A traditional VC time line is 10 years, when they have to give money back to investors, so in seven years they want to exit. A 15-year business plan isn’t going to fit in.” On the money side, the story is a little less forgiving. “They did not deliver on their promises to investors,” says Chad Anderson, whose Space Angels invested in PR. “Both companies were really good at storytelling and marketing and facilitating this momentum around a vision that their technology never really substantiated.” He adds, “I think that these weren’t the right teams to do it.” There were also bigger structural obstacles—such as, in former employees’ telling, the lack of any infrastructure for an asteroid--mining industry. That put investors off, too: “If you mine an asteroid, mostly likely you’ll [have to] send it to the moon to process it. It wouldn’t be processed on Earth, because the cost would be tremendous,” says Anderson Tan. “So then it’s like a chicken-and-egg problem: do we mine first and then develop a moon base, or invest in building up the moon and then go to asteroid mining?” On the money side, the story is a little less forgiving. Finally, asteroid miners had to compete for funding with a proliferating number of other space-related ventures. Between 2009—“the dawn of the entrepreneurial space age”—and today, “we’ve gone from a world with maybe a dozen privately funded space companies serving one client, the government, to one with more than 400 companies worth millions of bucks,” Chad Anderson says. So if commercial space startups seemed like an out-there proposition in 2012, by 2018 VCs who wanted space in their portfolios could have their pick of companies with better short-term prospects: telecom startups selling internet access, for instance, or firms analyzing the much-more-accessible moon. “The bottom line is that space is hard,” says Henry Hertzfeld, the director of the Space Policy Institute at George Washington University. (Hertzfeld advised Planetary Resources on legal matters; the space world, on Earth, is still very small.) “It’s risky, it’s expensive; lots of high up-front costs. And you need money. You can get just so much money for so long.” To succeed, says Hertzfeld, the companies would have needed to make a profit from other uses of their technology—such as DSI’s water propulsion system, which could be used in satellites, and PR’s hyperspectral sensors, which it built to analyze the composition of asteroids but can also be put to work surveying the Earth. “But they didn’t generate the revenues,” he says, “and there’s a limited amount of time for a company to exist without a profit.” According to Space Angels, $1.7 billion in equity capital poured into space companies in the first quarter of 2019, nearly twice as much as in the last quarter of last year. Of that, 79% went toward satellite businesses and 14% to logistical operations, like rocket launches. The fund’s own interests mirror these trends. “The commercial space industry is maturing to the point where it’s more serious now,” says Peter Ward, the author of The Consequential Frontier, a forthcoming book about the privatization of space. “Some of the people I talked to now see asteroid mining as a bit of a joke.” Building a new frontier In spite of these failures, former asteroid miners sound remarkably chipper about their prospects—and humanity’s interstellar future. Asteroid mining was a gateway drug for high hopes and big dreams. Tamara Alvarez, a doctoral student at the New School in New York who has attended space conferences around the world, says that the rhetoric around space mining maps perfectly onto older frontier tropes. “The mining thing resonated with a lot of people because of the gold rush narrative. There’s something unconscious there that they tapped into,” she says. Similarly, though neither asteroids nor 19th-century California actually created many overnight billionaires, they did create frameworks for how an economy based on a particular resource would function. “There wasn’t all the gold in California, but it brought an infrastructure that people made money off of,” says Alvarez. “Services, fishing—all this grew out of ambitions for gold. With asteroids, it’s the same thing: when you get the idea that there’s all the gold or whatever you need waiting for you, the infrastructure gets built too.” The asteroid miners seem to have thought of it that way. “I think when DSI and PR got started, the headlines all said asteroid-mining [companies] were like [traditional] mining companies,” says Grant Bonin. “But internally we’d joke: We’re not miners yet. We’re the pickax and shovel or Levi’s jeans of space. We’re the creators of tools that were brought into existence that would support the vision, but also help a lot of other people to do a lot more.” Equally significant is that the prospect of asteroid mining pushed governments to think about property rights in space. “The horizon for asteroid mining is still a couple of decades off, but I do think we’re going to do Mars missions, and we’ll need resources in space,” says Marquez. “And thanks to asteroid mining, the policy framework’s been established.”

Mining **cant** eliminate conflict- abundance produces conflict, it doesn’t eliminate scarcity due to *inequality*

RIEDERER 14

(RACHEL, Silicon Valley Says Space Mining Is Awesome and Will Change Life on Earth. That’s Only Half Right. <https://newrepublic.com/article/117815/space-mining-will-not-solve-earths-conflict-over-natural-resources> 5-19)

It’s exhilarating, this notion that tech advances could end scarcity as we know it, relegating wars over mineral wealth and energy sources to the list of woes defeated by science, alongside plague and polio. But it’s a dangerous exhilaration. It seems far more likely that new sources of wealth will, in their abundance, be one more thing for us to scrabble over. The space-mining notion is immensely appealing: the sky is full of infinite riches and abundance leads to peace. But why wouldn’t riches from the heavens cause conflicts and problems? Their vulgar terrestrial cousins always have. The problem with comparing space-mining to the Wild West isn’t just that it won’t revolutionize our economy like Manifest Destiny did. It isn’t even that there’s something suspect in taking the sky—something that feels so shared, so very deeply part of the commons—and turning it into a set of privately held commodities. It’s that this rhetoric gives the industry a kind of up-by-the-bootstraps patina, calling to mind a situation in which anyone with a gold-pan could go and seek their fortune, if one were plucky and lucky enough to set out for virgin territory. This simply does not apply to space mining, an industry where—to an even greater degree than modern-day resource extraction businesses on Earth—the barriers to entry in terms of both technology and capital are so immense that it is only open to entrepreneurs who are already billionaires.

Their tech optimism is misplaced- everything needs redesign for space

RIEDERER 14

(RACHEL, Silicon Valley Says Space Mining Is Awesome and Will Change Life on Earth. That’s Only Half Right. <https://newrepublic.com/article/117815/space-mining-will-not-solve-earths-conflict-over-natural-resources> 5-19)

The “getting there first” will not be simple, or cheap. Most of the asteroids in the solar system are in the asteroid belt between Mars and Jupiter. But the orbit paths of some near-Earth asteroids, or NEAs, bring them relatively close to our planet—that is, within around 30 million miles. Planetary Resources has developed what is essentially an outer-space drone: a small telescope-equipped spacecraft, around the size of a desktop computer, that will survey near-Earth asteroids. Once an asteroid is identified and determined to be valuable, the extraction could begin, though that introduces a new set of technical obstacles. Because of the difficulty and expense of getting heavy machinery from Earth into space, some have suggested using 3D printing technology to use materials found in space to create the necessary equipment. Then, some modified version of a terrestrial mining method, like drilling or magnetic separation, could be used for the mining itself. But these extraction processes have been developed for the pressure and gravity of Earth, and they would need to be overhauled to function in the low-gravity, vacuum environment of space.

If this part of the process sounds unclear, it’s because it is. To give an idea of the scale—in time and difficulty—of these kinds of operations, consider the government’s version of asteroid prospecting. In April, NASA greenlighted a mission in which a spacecraft called OSIRIS-REx will rendezvous with an asteroid called Bennu. OSIRIS-Rex is scheduled to launch in 2016, reach the asteroid in 2018, reconnoiter it for over a year, and then bring back samples for scientific study. The amount of asteroid that NASA plans to collect after all this time and trouble? Two ounces. A major premise of private space mining companies is that they will be able to work far faster and more economically than NASA, and will be willing to take on levels of risk beyond that of a government operation, but the scale and timeline of OSIRIS-REx shows how complex these operations will be, even for the swiftest companies.